

**OROVILLE FERC RELICENSING  
(PROJECT No. 2100)**


**INTERIM REPORT  
SP-F3.2 TASK 2  
SP-F21 TASK 1**

**APPENDIX A  
MATRIX OF LIFE HISTORY AND HABITAT REQUIREMENTS FOR  
FEATHER RIVER FISH SPECIES**

**LITERATURE REVIEW OF LIFE HISTORY AND  
HABITAT REQUIREMENTS FOR  
FEATHER RIVER FISH SPECIES**

**LARGEMOUTH BASS**

**JANUARY 2003**

Element	Element Descriptor	General	Feather River specific
<b>General</b>			
common name (s)	English name (usually used by fishers and laypeople).	Largemouth bass, largemouth black bass	
scientific name (s)	Latin name (referenced in scientific publications).	<i>Micropterus salmoides</i>	
taxonomy (family)	Common name of the family to which they belong. Also indicate scientific family name.	Sunfish and bass - <i>Centrarchidae</i>  The large <i>Centrarchidae</i> family includes sunfishes, crappies, and basses. Fishes of genus <i>Micropterus</i> are collectively referred to as “black basses.”	
depiction	Illustration, drawing or photograph.		
range	Broad geographic distribution, specifying California distribution, as available.	Largemouth bass are widely distributed in the continental U.S, Hawaii, most provinces in Canada, and worldwide (Moyle 2002).	
native or introduced	If introduced, indicate timing, location, and methods.	Largemouth bass were introduced to California from Illinois in 1891 (Moyle 2002).	In California, largemouth bass were planted in Cuyamaca Reservoir and in the Feather River. They were distributed statewide by anglers and biologists (Moyle 2002).

Element	Element Descriptor	General	Feather River specific
ESA listing status	Following the categories according to California Code of Regulations and the Federal Register, indicate whether: SE = State-listed Endangered; ST =State-listed Threatened; FE = Federally listed Endangered; FT = Federally-listed Threatened; SCE = State Candidate (Endangered); SCT = State candidate (Threatened); FPE = Federally proposed (Endangered); FPT = Federally proposed (Threatened); FPD = Federally proposed (Delisting); the date of listing; or N = not listed.	Largemouth bass are not listed.	
species status	If native, whether: Extinct/extirpated; Threatened or Endangered; Special concern; Watch list; Stable or increasing. If introduced, whether: Extirpated (failed introduction); highly localized; Localized; Widespread and stable; Widespread and expanding.	In freshwater, largemouth bass are “widespread and stable” (Moyle 2002).	
economic recreational value	or Indicate whether target species sought for food or trophy. Whether desirable by recreational fishers, commercial fishers, or both.	Largemouth bass are desired by recreational fishers. They are a favorite game fish in California reservoirs and sloughs, and support large fishing tournaments (Moyle 2002).	
warmwater coldwater	or Warmwater if suitable temperature range is similar to basses; coldwater if suitable temperature range is similar to salmonids.	Warmwater (Moyle 2002).	

Element	Element Descriptor	General	Feather River specific
pelagic or littoral	Environment: Pelagic - living far from shore; Littoral - living near the shore.	Littoral.  In reservoirs and lakes, largemouth bass remain close to the shore and seem to be most abundant in water 1-3 meters deep (Moyle 2002).	
bottom or water column distribution	Environment: bottom (benthic) or along water column.	Water column.  Largemouth bass generally inhabit warm, shallow waters less than 19.7 ft (6 m) deep (Moyle 2002).	
lentic or lotic	Environment: Lentic - pertaining to stagnant water, or lake-like; Lotic - moving water, or river-like.	Lentic.	
<b>Adults</b>			
life span	Approximate maximum age obtained.	Largemouth bass have been reported to live to a maximum age of 16 years. In California reservoirs, the average lifespan is 4-5 years (Moyle 2002).  Largemouth bass can live to a maximum age of 23 years (Green et al. 1994).  In the Northern U.S., largemouth bass live up to 15 years, while in the Southern U.S., largemouth bass live up to 11 years (Lock et al. 1997).	
adult length	Indicate: Length at which they first reproduce; average length and maximum length the fish can attain.	Maximum length largemouth bass attain is 29.9 inches (76 cm) TL. In California reservoirs, average length ranges from 13.8-17.7 inches (35-45 cm). Males typically spawn at lengths ranging from 7.1-8.3 inches (18-21 cm), while females spawn at lengths ranging from 7.9-9.8 inches (20-25 cm) (Moyle 2002).  Largemouth bass range in length from 4 inches (102 mm) at age 1 to 20.2 inches (514 mm) at age 15 (Beamesderfer et al. 1995).	
adult weight	Indicate: Weight at which they first reproduce; average weight and maximum weight the fish can attain.	Maximum weight attained by largemouth bass is 23.1 pounds (10.5 kg). In California reservoirs, largemouth bass average 1.3-4.9 pounds (0.6-2.2 kg) (Moyle 2002).	

Element	Element Descriptor	General	Feather River specific
physical morphology	General shape of the fish: elongated, fusiform, laterally compressed, etc.	Largemouth bass are elongated and become deeper-bodied with age (Moyle 2002).	
coloration	Indicate color, and color changes, if any, during reproduction phase.	Largemouth bass are typically olive gray to shiny green on the back and sides, and white on the belly, with a stripe in between. Largemouth bass have brown eyes (Moyle 2002).	
other physical adult descriptors	Unique physical features for easy identification.	Largemouth bass have a large mouth with maxillae that extend to or past the hind margin of the eyes (Moyle 2002).	
adult food base	Indicate primary diet components.	<p>At lengths ranging from 2.0-2.4 inches (50-60 mm) SL, largemouth bass feed on aquatic insects, and fish fry. At lengths ranging from 3.9-4.9 inches (100-125 mm) SL, largemouth bass feed on fish, crayfish, tadpoles, and frogs. In California reservoirs, adults feed on threadfin shad, golden shiners and bluegill (Moyle 2002).</p> <p>Adult largemouth bass feed on invertebrates and a variety of fish (Miller et al. 1984).</p> <p>Adult largemouth bass feed on green sunfish and bluegill (Savitz et al. 1982).</p> <p>The food base for adult largemouth bass consists of sunfish, bluegill, glut herring, golden shiner, coastal shiner, yellow and brown bullheads, mosquitofish, brook silverside, yellow perch, Cyprus darter, damsel and dragonfly nymphs, midge and mayfly larvae, leeches, crayfish, and plant material (Bennet et al. 1972).</p>	
adult feeding habits	Indicate whether plankton eater, algae eater, bottom feeder, piscivorous, active hunter, ambush predator, filter feeder. Night, day, dusk or dawn feeder.	<p>Adult largemouth bass are solitary hunters (Moyle 2002).</p> <p>Adult largemouth bass over 2.4 inches (60 mm) in length may be piscivorous (Bettoli et al. 1992).</p>	
adult in-ocean residence time	For anadromous species, age when they migrate to the ocean and duration spent in the ocean before returning to freshwater to spawn.	N/A	

Element	Element Descriptor	General	Feather River specific
adult habitat characteristics in-ocean	For anadromous species, description of the ocean habitat utilized: whether along major current systems, gyres, pelagic (beyond continental shelves) and neritic (above continental shelves) zones, etc.	N/A	
<b>Adult upstream migration (immigration)</b>			
range of adult upstream migration timing	Time of year adults migrate upstream. If applicable, indicate for various runs.	N/A	
peak adult upstream migration timing	Time of year most adults migrate upstream. If applicable, indicate for various runs.	N/A	
adult upstream migration water temperature tolerance	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	N/A	
adult upstream migration water temperature preference	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental.	N/A	
<b>Adult holding (freshwater residence)</b>			
water temperature tolerance for holding adults	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	<p>Reported optimal water temperatures for growth range from 77°F-86°F (25°C-30°C). Adult largemouth bass can exist in water temperatures as high as 96.8°F-98.6°F (36°C-37°C) (Moyle 2002).</p> <p>Water temperatures tolerated by largemouth bass range from 77°F-86°F (25°C-30°C) (Coutant et al. 1983).</p> <p>In winter and fall in South Carolina, largemouth bass tolerate temperatures ranging from 60.8°F-77°F (16°C - 25°C) (Bennet et al. 1972).</p>	

Element	Element Descriptor	General	Feather River specific
water temperature preference for holding adults	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental.	Reported optimal water temperature for largemouth bass is 80.6°F (27°C) (Moyle 2002).  Suitable water temperatures for largemouth bass range from 77°F-84.2°F (25°C -29°C) (Coutant et al. 1983).	
water depth range for holding adults	Reported range of observed (minimum and maximum) water depth utilization.	Adult largemouth bass reside in water depths ranging from 3.3-9.8 ft (1-3 m) (Moyle 2002).	
water depth preference for holding adults	Reported range of most frequently observed water depth utilization.	Largemouth bass adults prefer water depths less than 19.7 ft (6 m) (Moyle 2002).	
substrate preference for holding adults	If bottom dwellers, indicate substrate: mud, sand, gravel, boulders, aquatic plant beds, etc. If gravel, indicate range or average size of gravel.	Adult largemouth bass prefer warm, shallow waters of moderate clarity and beds of aquatic plants. They are found in farm ponds, lakes, reservoirs, sloughs, and river backwaters where other nonnative fish are abundant, and where there is heavy growth of aquatic plants (Moyle 2002).	
water velocity range for holding adults	Reported range of observed (minimum and maximum) water velocity utilization.		
water velocity preference for holding adults	Reported range of most frequently observed water velocity utilization.		
other habitat characteristics for holding adults	General description of habitat (e.g. turbid or clear waters, lentic or lotic, presence of aquatic plant beds, debris, cover, etc.).	In native habitats, largemouth bass are known to live in estuarine conditions with salinities up to 16 ppt. In California, it is unusual to find them in salinities much higher than 3 - 5 ppt, and they are abundant in tidally influenced freshwater sloughs of the Delta (Moyle 2002).	
timing range for adult holding	Time of year (earliest-latest) and duration of stay from upstream migration to spawning.		
timing peak for adult holding	Time of year when maximum number of adults are present before spawning.		

Element	Element Descriptor	General	Feather River specific
<b>Spawning</b>			
fecundity	Average or range in the number of eggs females lay in a spawning season.	<p>Female largemouth bass lay between 2,000-110,000 eggs per female. Fecundity increases with age, weight and length of female (Wang 1986).</p> <p>A female may lay between 2,000-94,000 eggs, depending on body size (Moyle 2002).</p> <p>Average fecundity is approximately 4,000 eggs per pound of body weight; up to 80,000 eggs per female has been reported (Lock et al. 1997).</p>	
nest construction	Location and general description of nest -- substrates, aquatic plants, excavations, crevices, habitat types, etc.	Largemouth bass nests are shallow depressions up to 3.3 ft (1 m) in diameter in sand, gravel, or debris littered bottoms at depths of 1.6-6.6 ft (0.5-2 m). Nests are often built next to submerged objects, logs or boulders (Moyle 2002).	
nest size	Size and average dimensions of the nest.	The largemouth bass nest is circular and its diameter is approximately twice the body length of the male (Lock et al. 1997).	
spawning process	Indicate whether nest builder, broadcast spawner, or other.	Largemouth bass are nest builders (Moyle 2002).	
spawning substrate size/characteristics	Range of substrates used during spawning (e.g. mud, sand, gravel, boulders, beds of aquatic plants). Indicate presence of plant/wood debris, crevices at spawning sites. If gravel, indicate range of average size.	<p>Spawning occurs mostly over gravel, sand, and mud substrate below boulders (Wang 1986).</p> <p>Largemouth bass spawning occurs next to submerged objects, such as logs or boulders (Moyle 2002).</p> <p>Spawning occurs over firm substrate such as sand, gravel or clay. Nests have also been observed on tree roots, on clumps of aquatic vegetation and in pits in compacted mats of dead, fibrous aquatic vegetation (Bruno et al. 1990).</p> <p>Spawning occurs over hard substrates such as sand or gravel and under cover or any form of structure that is available (Lock et al. 1997).</p>	



Element	Element Descriptor	General	Feather River specific
preferred spawning substrate	Indicate preferred spawning substrate (e.g. mud, sand, gravel, boulders, plant bed, etc).		
water temperature tolerance for spawning	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	<p>Spawning begins at water temperatures ranging from 57.2°F-60.8°F (14°C-16°C) and occurs in water temperatures up to 75.2°F (24°C) (Wang 1986).</p> <p>Nest building begins at water temperatures of 59°F-60.8°F (15°C-16°C) and spawning continues to water temperatures of 75.2°F (24°C) (Moyle 2002).</p> <p>Spawning occurs at water temperatures ranging from 53.6°F-68°F (12°C-20°C) (Miller et al. 1984).</p> <p>In lab conditions, spawning occurred at 68°F (20°C) (Carlson 1973).</p> <p>Largemouth bass spawning occurs at water temperatures ranging from 65°F-75°F (18.3°C-23.9°C) (Lock et al. 1997).</p>	
water temperature preference for spawning	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.		
water velocity range for spawning	Minimum and maximum speed of water current the spawning fish can tolerate.		
water velocity preference for spawning	Preferred water current (flow velocity) during spawning.		
water depth range for spawning	Reported range of observed (minimum and maximum) water depth utilization.	<p>Mean nest depth for largemouth bass is 2 ft (0.6 m) (Sammons et al. 1999).</p> <p>Spawning occurs at water depths of 1.6-6.6 ft (0.5-2 m). In California, with changing reservoir levels, spawning has been observed at water depths up to 13.1-16.4 ft (4-5 m) (Moyle 2002).</p> <p>Largemouth bass spawning occurs in water 1-4 feet deep near shore and has been observed as deep as 20 ft in</p>	

Element	Element Descriptor	General	Feather River specific
		clear water (Lock et al. 1997).	
water depth preference for spawning	Reported range of most frequently observed water depth utilization.		
range for spawning timing	Earliest and latest time of season or year in which spawning occurs.	Spawning occurs from April to June (Wang 1986).  In southern California, spawning may begin as early as March, while spawning in northern California generally begins in April. Spawning lasts through June (Moyle 2002).  Spawning occurs over approximately 45 days from late April to early June (Miller et al. 1984).	
peak spawning timing	Time of year most fish start to spawn.	Peak largemouth bass spawning occurs in early May (Wang 1986).	
spawning frequency (iteroparous/semelparous)	Semelparous - producing all offspring at one time, such as in most salmon. Usually these fish die after reproduction. Iteroparous - producing offspring in successive, e.g., annual or seasonal batches, as is the case in most fishes.	Largemouth bass are iteroparous (Moyle 2002).	
<b>Incubation/early development</b>			
egg characteristics	Shape, size, color, in clusters or individuals, stickiness, and other physical attributes.	Eggs are spherical, ranging from 0.06-0.07 inches (1.5-1.7 mm) in diameter. They are adhesive, transparent, thin, and demersal (Wang 1986).	
water temperature tolerance for incubation	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	Nesting success was reduced if water temperature was reduced below 60°F (15.5°C) (Lock et al. 1997).  Eggs hatch at water temperatures ranging from 55.4°F–69.8°F (13°C-21°C) (Sammons et al. 1999).	
water temperature preference for incubation	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.		

Element	Element Descriptor	General	Feather River specific
time required for incubation	Time duration from fertilization to hatching. Note: Indicate at which temperature range. Incubation time is temperature-dependent.	Eggs hatch in 5 days at water temperatures of 66°F (18.9°C), while eggs hatch in 2 days at water temperatures of 72°F (22.2°C) (Wang 1986).  Eggs hatch in 2-7 days and sac fry spend 5-8 days in the nest (Moyle 2002).  Eggs hatch in 2-4 days in the southern U.S., depending on water temperature (Lock et al. 1997).	
size of newly hatched larvae	Average size of newly hatched larvae.	Newly hatched larvae may be as small as 0.09 inches (2.3 mm) TL. Recently hatched fish collected in the field range from 0.14-0.16 inches (3.6-4.1 mm) total length (Wang 1986).	
time newly hatched larvae remain in gravel	Time of year of hatching, and duration between hatching and emergence from gravel.	Hatching occurs from early April through early June (Sammons et al. 1999).	
other characteristics of larvae	Alevin -- early life history phase just after hatching (larva) when yolk-sac still present.		
timing range for emergence	Time of year (earliest-latest) hatchlings (larvae and alevins) leave or emerge from the nesting/hatching (gravel) sites.		
timing peak for emergence	Time of year most hatchlings emerge.		
size at emergence from gravel	Average size of hatchlings at time of emergence.		
<b>Juvenile rearing (in freshwater)</b>			
general rearing habitat and strategies	General description of freshwater environment and rearing behavior.	Young-of-year and yearlings stay close to the shore in schools that cruise above or near aquatic plant beds. Schools of juveniles tend to remain in limited areas and are more active during the day than at night (Moyle 2002).	
water temperature tolerance for juvenile rearing	Extreme water temperatures rearing juveniles can survive. Indicate whether these extremes are stress or lethal levels.	Reported optimal range of water temperatures for juvenile largemouth bass range from 77°F-86°F (25°C-30°C) (Coutant et al. 1983).	

Element	Element Descriptor	General	Feather River specific
		Growth can occur over a wide range of water temperatures, ranging from 50°F-95°F (10°C -35°C) (Moyle 2002).	
water temperature preference for juvenile rearing	Optimum temperature range for rearing juveniles for growth.	Reported optimal water temperatures for growth of bass over 3.9 inches (10 cm SL) are 77°F-86°F (25°C -30°C), but juveniles largemouth bass actually prefer water temperatures ranging from 86°F-89.6°F (30°C -32°C) (Moyle 2002).  In lab conditions, largemouth bass juveniles prefer water temperatures of 80.6°F (27°C) (Coutant et al. 1983).	
water velocity ranges for rearing juveniles	Minimum and maximum water velocities (flows and currents) the rearing juveniles can tolerate.		
water velocities preferred by rearing juveniles	Optimum range of water velocities for rearing juveniles.		
water depth range for juvenile rearing		Young-of-year and yearlings stay close to the shore in schools (Moyle 2002).	
water depth preference for juvenile rearing			
cover preferences for rearing juveniles	Type of cover for protection from predator used by rearing juveniles (e.g. crevices, submerged aquatic vegetation,	Young-of-year yearlings cruise above or near aquatic plant beds (Moyle 2002).	

Element	Element Descriptor	General	Feather River specific
	overhanging vegetation, substrate cover, undercover bank, small woody debris, large woody debris).		
food base of juveniles	Indicate primary diet components, i.e. what they eat. Also indicate the diet changes, if any, as they grow.	<p>Fry feed on rotifers and small crustaceans, and by the time they reach 1.9-2.4 inches (50-60 mm) SL, largemouth bass primarily feed on aquatic insects and fish fry, including fry of their own species. When juveniles reach 3.9-4.9 inches (100-125 mm) SL, they feed mainly on fish (Moyle 2002).</p> <p>Fry feed on small crustaceans, while young feed on crustaceans, insects and other fish (Dill 1948).</p> <p>Juveniles feed on aquatic insect, amphipods, and grass shrimp (Bettoli et al. 1992).</p>	
feeding habits of rearing juveniles	Indicate: Plankton eaters, bottom feeders, piscivorous, active hunters, ambush predators, filter feeders. Night, day, dusk or dawn feeders. Also indicate change of feeding habits as they grow.	Juveniles are active hunters, capable of changing foraging behavior in accordance with prey availability, type of habitat, experience and body size; active most of the day and moonlit nights (Moyle 2002).	
predation of juveniles	Indicate which species prey on juveniles.		
timing range for juvenile rearing	Range of time of year (months) during which rearing occurs.		
timing peak for juvenile rearing	Time of year (months) during which most rearing occurs.		
<b>Juvenile emigration</b>			
time spent in fresh water prior to emigrating	Duration (in years and/or months) from emergence to emigration to the ocean.	N/A	

Element	Element Descriptor	General	Feather River specific
water temperature tolerances during emigration	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	N/A	
water temperature preferences during emigration	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.	N/A	
emigration timing range	Time of year juveniles commence emigration and duration of emigration	N/A	
emigration timing peak	Time of year most juveniles are emigrating.	N/A	
size range of juveniles during emigration	Minimum and maximum sizes (inches or mm) of emigrating juveniles. Indicate average size.	N/A	
factors associated with emigration	Pulse flows, water temperature changes, turbidity levels, photoperiod, etc.	N/A	
<b>Other potential factors</b>			
DO	Levels of dissolved oxygen in water expressed in mg/L tolerated by fish.	Largemouth bass can persist in water temperatures ranging from 96.8°F-98.6°F (36°C -37°C) during the day with dissolved oxygen levels as low as 1 mg/L (Moyle 2002).  At 68°F (20°C) and 73.4°F (23°C), oxygen concentrations as low as 35% of saturation are adequate for embryo and larva survival (Carlson et al. 1974).	
pH	Alkalinity/acidity of water (expressed in pH) that fish can tolerate.	Maximum pH tolerated by largemouth bass if pH 9 (Moyle 2002).	
turbidity	Indicate turbidity or state of water (e.g., clear water or presence of siltation or organic/inorganic matter in water) that fish can tolerate.	Largemouth bass typically inhabit warm, shallow water of moderate clarity (Moyle 2002).	

Element	Element Descriptor	General	Feather River specific
factors contributing to mortality	e.g., fishing/angling mortality, drastic habitat alterations, unfavorable climatic changes, etc.	Fishing and angling are sources of mortality for largemouth bass (Green 1995).  Overfishing, reservoir aging, and competition are factors contributing to mortality (Moyle 2002).	
<b>Predation-related characteristics</b>			
consumption rates by size	Rate of consumption of prey by predator size.	Under laboratory conditions, largemouth bass have not been observed to ingest prey of body depth greater than their own external mouth width (Hambright 1991).  Relative size of predators to prey reaches 40% to 50% for young predators, 20% to 25% for adult predators, and only 10% for very large predators (Lewis et al. 1974).	
consumption rates by lifestage	Rate of consumption of prey by predator lifestage.		
consumption rates by water temperature	Rate of consumption of prey by water temperature.	Generally, largemouth bass do not feed at temperatures below 50°F (10°C) (Adams et al. 1982).  Food consumption increases at warmer water temperatures. In a lab study, mean group consumption (N=5) of fathead minnows over 36 days for large (5.4-5.5 inches (136-140 mm)) largemouth bass was 0.14 oz/day (3.9 g/day) at 57.2°F (14°C), 0.3 oz/day (8.6 g/day) at 68°F (20°C), and 0.87oz/day (24.6 g/day) at 78.8°F (26°C). Small (108-113 mm) largemouth bass consumed fathead minnows at a rate of 0.11 oz/day (3.0 g/day) at 57.2°F (14°C), 0.18 oz/day (5.0 g/day) at 68°F (20°C), and 0.64 oz/day (18.2 g/day) at 78.8°F (26°C) in a 24 hour period (Smagula et al. 1982).	
growth rate	Rate at which growth occurs.	Approximately 5 pounds (2.3 kg) of forage are required for annual maintenance, and approximately 10 pounds (4.5 kg) of forage are required for a largemouth bass to gain 1 pound (0.45 kg) (Lock et al. 1997).	
community interactions (predators)	Known predators.		

Element	Element Descriptor	General	Feather River specific
community interactions (prey)	Known prey.	<p>In California reservoirs, largemouth bass feed largely on threadfin shad, golden shiners, and bluegill (Moyle 2002).</p> <p>Largemouth bass is considered a probable “keystone” predator in some localities. A keystone species causes changes throughout the ecosystem, usually by changing abundances of favored prey. Although poorly documented, the decline and disappearance of native minnows followed their introductions, such as into Clear Lake (Moyle 2002).</p> <p>Largemouth bass prey on invertebrates and miscellaneous fish (Miller et al. 1984).</p> <p>Largemouth bass prey on green sunfish and bluegill (Savitz et al. 1982).</p> <p>In Crab Orchard Lake, Illinois, gizzard shad, bullheads, crayfish, centrarchids constitute largemouth bass prey (Lewis et al. 1974).</p>	
community interactions (competitors)	Known competitors.	Threadfin shad compete with largemouth bass in early lifestages (Moyle 2002).	
predator diet by size	Diet of fish by size classes.	<p>In California, for the first few months following hatching, largemouth bass feed primarily on rotifers and small crustaceans. By the time they reach 2-2.4 inches (50-60 mm) SL, the diet shifts to largely aquatic insects and fish fry, including their own species. At 3.9-4.9 inches (100-125 mm) SL, they subsist primarily on fish. (Moyle 2002).</p> <p>In Lake Conroe, Texas, fish constituted the majority of the diet of largemouth bass ranging in length from 1.6-2.4 inches (41-60 mm), and all largemouth bass over 2.4 inches (60 mm) consumed only fish. The most commonly identified fish consumed by largemouth bass was silverside and the most commonly identified fish in larger largemouth bass was shad (Bettoli et al. 1992).</p> <p>Largemouth bass in the Sacramento –San Joaquin Delta consumed the following prey (based on stomach content</p>	



Element	Element Descriptor	General	Feather River specific
		analysis of 50 individuals 6.3-19.3 inches (16-49 cm) long) (Turner 1966): (1) crustaceans including Mysid shrimp ( <i>Neomysis awatschensis</i> ), amphipods ( <i>Corophium</i> ), and crayfish ( <i>Pacifastacus leniusculus</i> ); (2) insects including tendipedids; (3) amphibians including bullfrog ( <i>Rana catesbeiana</i> ); and (4) fish including threadfin shad ( <i>Dorosoma petenense</i> ), Chinook salmon ( <i>O. tsawytscha</i> ), bluegill ( <i>Lepomis macrochirus</i> ), black crappie ( <i>Pomoxis nigromaculatus</i> ), and other unidentified fish.	
predator diet by age group	Diet of fish by age group.		
association of predators to physical facilities including habitat conditions created by operations	Habitat conditions created by operations that are conducive to predation (velocities, temperatures).	Through a literature review of studies completed, it was concluded that Columbia River impoundments increase availability of microhabitats within the range preferred by northern pikeminnow and other predators (smallmouth and largemouth bass) (Northwest Fisheries Science Center 2000).	
association of predators to physical facilities including instream flow obstructions/diversions	Instream flow obstructions and/or diversions associated with structures and facilities that are conducive to predation.	Dam-related passage problems and reduced river discharge can affect the availability, distribution, timing, and aggregation of migrating salmons, thereby increasing exposure time to predation. In particular, increasing exposure time later in the season when predator (smallmouth and largemouth bass) consumption rates are high may increase predation (Northwest Fisheries Science Center 2000).	
association of predators to physical facilities including unusual flow and/or water temperature patterns	Flow or water temperature associated with structures, or operations facilities that are conducive to predation.	Through literature review of previous studies completed, it was concluded that Columbia River, impoundments increase local water temperatures which increases digestion and consumption rates by pikeminnow and other predators (smallmouth and largemouth bass) (Northwest Fisheries Science Center 2000).	

## References

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